

VIII. *A Delineation of the Transit of Venus expected in the Year 1769, by Mr. James Ferguson.*

*To the Right Honourable the Earl of Macclesfield,  
President of the Royal Socie'y.*

My Lord,

Read Feb. 10, 1763. I Beg leave to present to the Royal Society a delineation of the transit of Venus in the year 1769 [T A B. I.] which will be a much better transit for discovering the Sun's parallax than that in 1761 was.

Although I have only mentioned Wardhuys in Norwegian Lapland, and the Solomon isles in the great South Sea, as proper places for observing that transit; yet I am sensible, that any other place near the north cape will be just as well for the northern observers; and Tuberon's Isle, or St. Bernard's, or the Fly Islands, in the great South Sea, will answer as well for the Southern.

Although it cannot be expected, that any delineation can be so exact as calculation, yet I hope this projection will be found to come very near the truth; and am, with the highest respect,

My Lord

your Lordship's  
and the Royal Society's  
most obliged humble servant

James Ferguson.

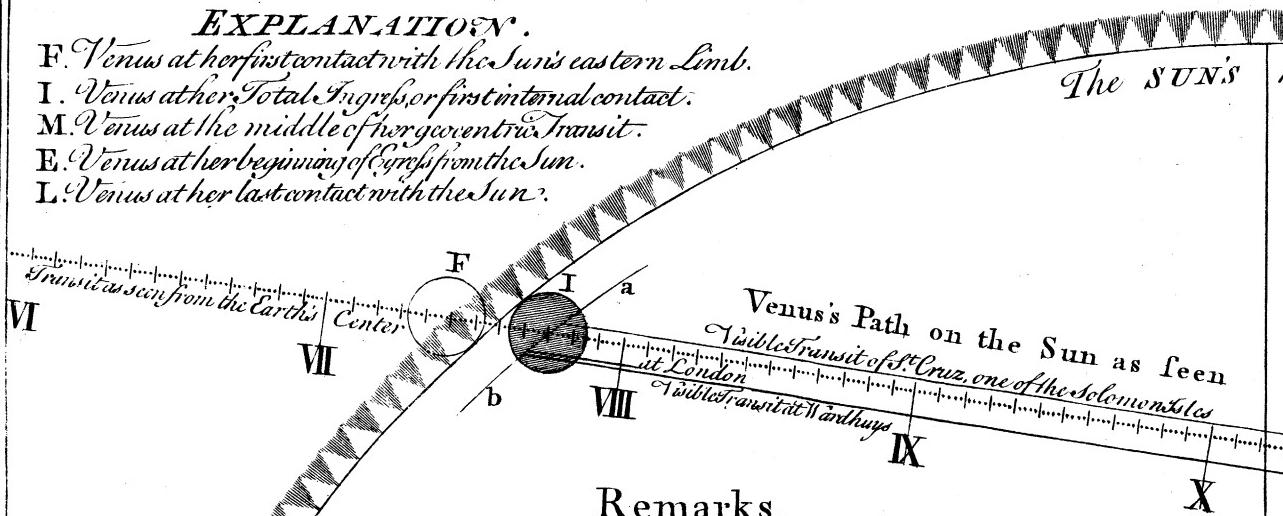
Mortimer-Street,  
Feb. 10, 1763.

IX. *An*

# The TRANSIT of VENUS over the SUN, June 3<sup>d</sup>. 1769. Delineated by James Ferguson.

## EXPLANATION.

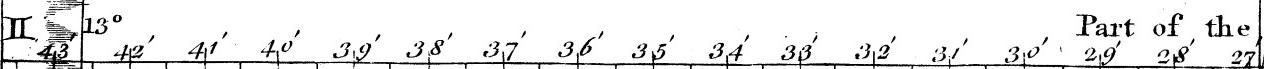
- F. Venus at her first contact with the Sun's eastern Limb.
- I. Venus at her Total Ingress, or first internal contact.
- M. Venus at the middle of her greatest Transit.
- E. Venus at her beginning of Egress from the Sun.
- L. Venus at her last contact with the Sun.



## Remarks.

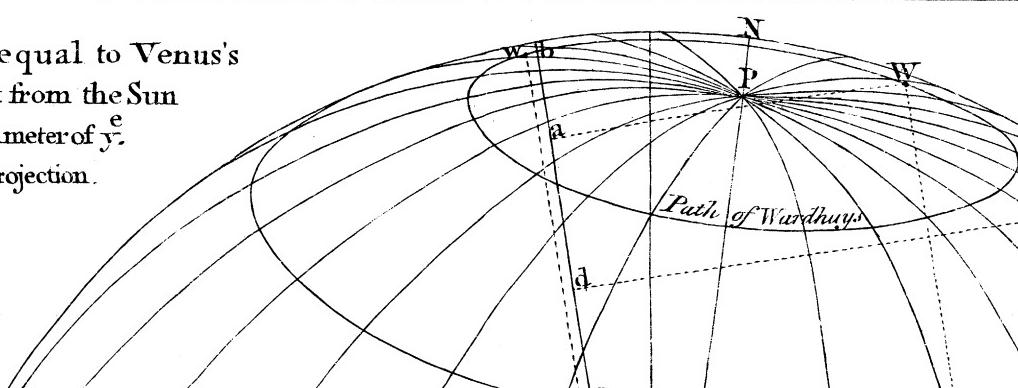
The most proper place for observing this Transit would be Wardhuys, a town in Norway, Lapland, & some of the Solomon Islands (as St. Cruz) in the Great South Sea. For in both these places the whole Transit will be seen from beginning to ending. Moreover, in Lapland the time of the visible Transit will be longer than the transit line supposed to be seen from the Earth's center; and the time of the Planets describing it will be yet longer on account of its apparent motion being slower by Lapland's moving the same way. But at the Solomon Islands the visible time of the Transit will be shorter than that supposed to be seen from the Earth's center; and the time of Venus's describing it will be still more shortened on account of the apparent quickness of her motion arising from a bring in a contrary direction to the motion of the Solomon Islands. We have assumed  $8\frac{1}{2}$  for the quantity of the sun's parallax in this delineation; and if that be its true quantity, the duration of the Transit will be 25 minutes + seconds longer as seen from Wardhuys than as seen from the Solomon Islands supposing them 140° west of London; the visible Latitude of Venus at the middle of her Transit will be 32' greater at Wardhuys than at Wardhuys.

If the sun's parallax be either greater or less than  $8\frac{1}{2}$  the difference of the visible durations of the Transit will be greater or less accordingly. So that if these differences be well ascertained by Observation, the sun's parallax will thereby be found, and consequently his distance from the Earth, and from every other Planet in the Solar System.



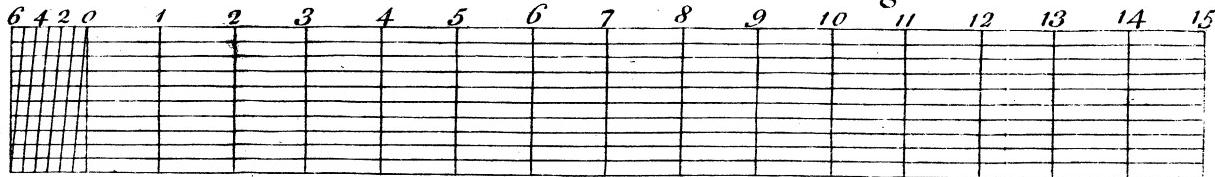
Scale of 21.3, equal to Venus's horizontal Parallax from the Sun and to the Semidiameter of the Earth's Disc in this Projection.

20	5
30	



Axis of the Ecliptic

## Scale of Minutes and Seconds of a Degree.



## *EXPLANATION:*

The larger divisions are minutes of a Degree, and the smaller ones are Seconds. The Distances of the Sun & Venus, & the geocentric Latitude of Venus, are laid down from this Scale, according to the tabular Elements. The Parallaxes of Venus's Latitude as seen from Mars always and from the Solomon Isles, both at the times of total Ingress and beginning of Egress are taken from this Scale, and set off from the geocentric Transit line by marks, and through these marks the lines of the visible Transits are Drawn. All the parallaxes are delineated on the Earth's Disc, and measured on the Scale on the left hand.

# different Parts of the Earth

XII

XII

c

1

四

三

## The Times and Durations of the TRANSIT.

- 1

  - As they would be if either the Sun  
nor Venus had any Parallax. | As they will be on Account of the  
Parallaxes of the Sun and Venus.

Equal times at	Total Ingress	Beg. of Egress	Total Ingress	Beg. of Egress	Duration
	H. M. S.	H. M. S.	H. H. S.	H. M. S.	H. H. S.
The Earthcenter	VII 45 0 A.	I 24 0 M.	13 Parallax	13 Parallax	5 39 0
Wardhuys.	IX 45 0 A.	III 24 0 M.	IX 37 25 A.	III 29 5 M.	5 51 40
LONDON.	VII 45 0 A.	I 24 0 M.	VII 37 30 A.	Invisible	—
St. Cruz Isle.	X 25 0 M.	III 4 0 A.	X 29 56 M.	III 55 55 A.	5 25 59

## ECLIPTIC

$\frac{2}{1} 6'$   $\frac{2}{1} 5'$   $\frac{2}{1} 4'$   $\frac{2}{1} 3'$   $\frac{2}{1} 2'$   $\frac{2}{1} 1'$   $\frac{2}{1} 0'$   $19'$   $18'$   $17'$   $16'$   $15'$   $14'$   $13'$   $12'$   $11'$  III

# An Orthographical Projection of the Earth's enlightened Disc as seen from the SUN during the time of the TRANSIT

EXPLANATION

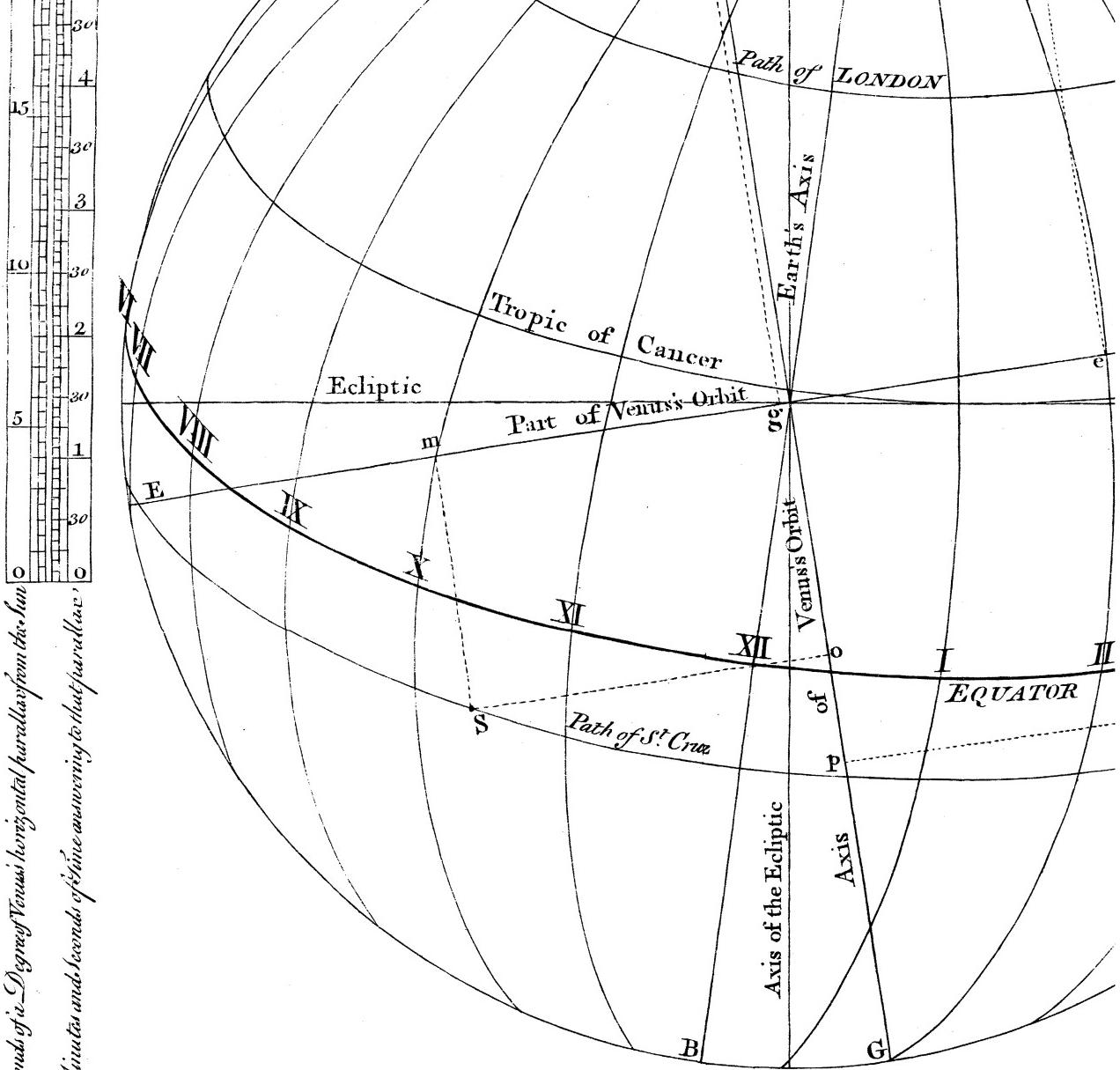
N.L.B. The Earth's enlightened Disc, on which are delineated the Equator, Tropic of Cancer, &c. &c. &c. &c. &c.

re  
itudo  
dar -  
seen  
'es, both  
uring  
nd.  
nsit  
those  
visible  
All the  
reated  
e and  
a scale  
nd.

.....

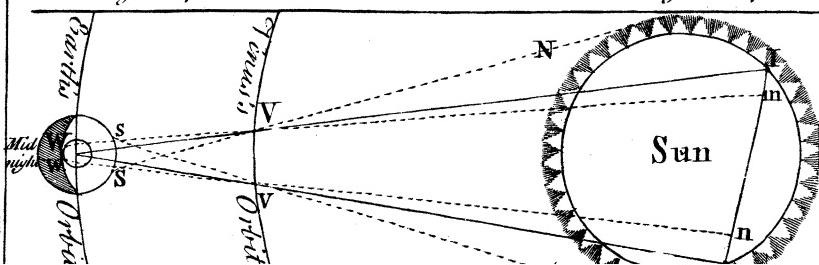


II.



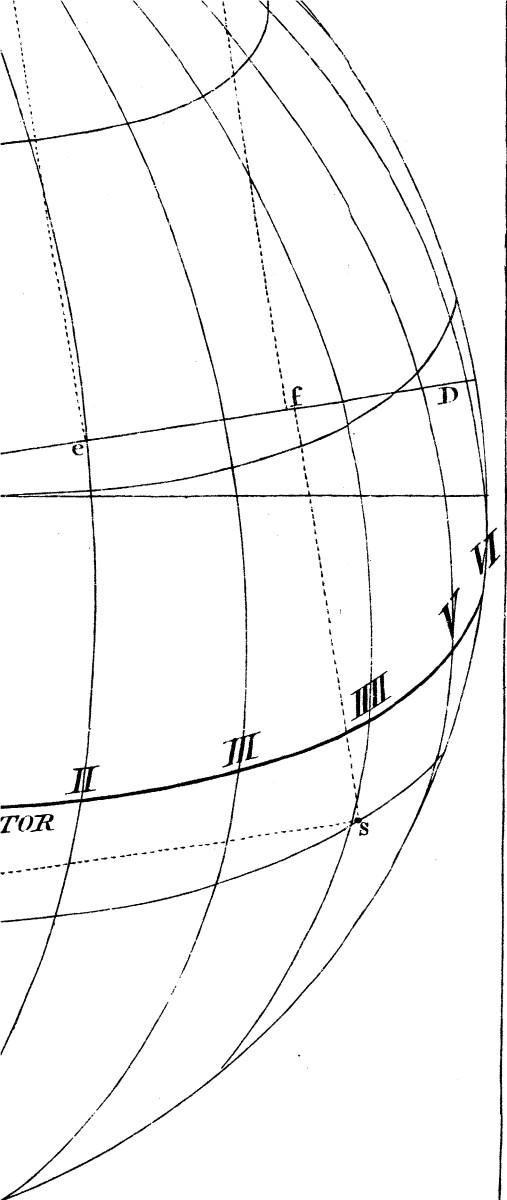
## The Elements from which these Projections are deduced.

	D. H. M. S.
1. True time at Greenwich of Conjunction of the Sun & Venus June 2...	3.10.11.0 PM
2. Their true places in the Ecliptic then as seen from the Earth's center	2.13.26.51
3. The Sun's Declination North	22.27.20
4. The Place of Venus's Ascending Node	2.14.36.14
5. Her Geocentric Latitude at that time, North Descending	10.22
6. The angle of her visible path with the Ecliptic	8.30.10
7. Her Geocentric horary motion on or from the Sun	3.59 $\frac{1}{4}$
8. The Sun's distance from the Earth	101523
9. Venus's distance from the Sun	72627
10. Her distance from the Earth	48896
The Sun's mean distance	
in parts from the Earth's center being 100000 of such parts.	
11. The Sun's horizontal parallax, assumed	
12. And consequently, Venus's horizontal	
13. Their difference = Venus's horizontal	
14. The Sun's Semidiameter	
15. Venus's Semidiameter	
16. Latitude of Wardhuys North	
17. Its Longitude East from Rome	
18. Latitude of London & North	
19. Latitude of Marquesas one of the Solomon	
20. Its Longitude West from London, suppose	



**EXPLANATION.** In this Diagram, *S* turns on its Axis according to the order in her Orbit at *V*, she will appear upon *m* as seen from the Earth's center, but at the Isle at *S*, she will be in the line *SVN*, as then seen from Wardhuys at *W*, she the Sun at *m*, so that her total Ingress huys, & later, as seen from St. Cruz, than as seen

# EXPLANATION.



N L B. The Earth's enlightened Disc, on which are delineated the Equator, Tropic of Cancer, diurnal Paths of Wardhuys, London, Island of St. Cruz, as seen from the Sun; and the parallaxes of Venus's longitude and latitude as seen from those Places, at y. times of Cruz's two internal contacts with the Sun?

E g D. A small part of Venus's Orbit, and b g G its Axis.

N g B. The Earth's Axis and Universele Meridian. P its North Pole.

W. .... The situation of Wardhuys on the Earth's Disc as seen from the Sun at the time of Venus's total Ingress as seen from the Earth's Center; & w the situation of Wardhuys when Venus's Egress from the Sun begins.

W a. Venus's Parallax in Longitude =  $10^{\circ} 34'$ , westward as seen from Wardhuys at the time of her total Ingress on the Sun as seen from the Earth's center, and W b her parallax in Latitude =  $18^{\circ} 33'$  southward at that time.

W b. Venus's parallax in Longitude =  $\frac{1}{2}$  eastward as seen from Wardhuys at the time when her Egress from the Sun begins, as seen from the Earth's center, and W g, her parallax in Latitude =  $21^{\circ} 34'$  southward, at that time.

L. .... The situation of London on the Earth's Disc, as seen from the Sun at the time of Venus's total Ingress as seen from the Earth's center.

L d. Venus's parallax in Longitude =  $16^{\circ}$  Westward as seen from London at the time of her total Ingress as seen from the Earth's center; and L f her parallax in Latitude =  $14^{\circ}$  at that time. Her Egress is invisible at London.

S. .... The situation of St. Cruz Isle on the Earth's Disc as seen from the Sun at the time of Venus's total Ingress as seen from the Earth's center, and s, the situation of St. Cruz when Venus's Egress from the Sun begins.

S o. Venus's Parallax in Longitude =  $11^{\circ} 32'$  Eastward, as seen from St. Cruz at the time of Venus's total Ingress as seen from the Earth's center; & S m her parallax in Latitude =  $8^{\circ} 32'$  at that time, & North?

S p. Venus's Parallax in Longitude =  $16^{\circ} 44'$  Westward, as seen from St. Cruz at the time when her Egress begins as seen from the Earth's Center, and S f her parallax in Latitude =  $12^{\circ} 30'$  Northward at that time.

All these parallaxes are measured on the Scale at the left hand, and the times by which the total Ingress of Venus, & her beginning of Egress, are accelerated or retarded by her parallax in Longitude, are found in the Scale, right against that parallax. An eastern parallax in Longitude retarded the Ingress, or Egress as seen from any given place, with respect to the time thereof as seen from the Earth's center, and a western parallax in Longitude accelerates it. A northern parallax in Latitude retarded the time of Ingress, as seen from any given place, & accelerates the time of Egress, by the number of Minutes that the half-transit Line on the Sun's Disc is shorter as seen from the given place than as seen from the Earth's center, when Venus passes above the Sun's center, as in this Transit; & a Southern parallax in Latitude accelerates the Ingress, and retarded the Egress, as seen from any given place, with respect to the time thereof as seen from the Earth's center, by the number of Minutes that the half-transit line on the Sun is longer as seen from the given place than as seen from the Earth's center. And these differences are found by measuring with compasses in the above Figure of the Sun's Disc, from the Axis of Venus's Orbit to the Arc a b where Venus's center is at the instant of total Ingress; and to the Arc c d where her center is when her Egress begins. And thus, the times of total Ingress, and beginning of Egress as seen from the above mentioned places, were found, as exprest in the Table of the Times and Durations of the Transit.

deduced.

assumed to be?	0.00.8.5
horizontal parallax?	0.00.29.8
horizontal parallax from the Sun?	0.00.21.3
	0.15.45.5
	0.00.29.5
orth?	71.00.0
in London (in time 2 hours)	30.00.0
orth?	51.30.0
Solomon Isles/South supposed to be	11.00.0
lon supposed to be (in time 9.20 m)	140.00.0

Diagram. S & Ww represents the Earth which the order of the letters. When Venus is upon the Sun at L, at her total Ingress, but at the same time, as seen from St. Cruz e SVN, not entered upon the Sun; and tW, she will appear to be advanced upon her Ingress will be sooner, as soon from Wardhuys as seen from the Earth's center.

As Venus moves from V to w in her Orbit, St. Cruz moves the contrary way, from S to s, and Wardhuys the same way, from W to w. When Venus is at v in her Orbit, she will appear on the Sun at E, at her beginning of Egress, as seen from the Earth's center; but at that time, she will be quite clear of the Sun, in the line svO, as seen from St. Cruz then at S; and as seen from Wardhuys, then at w, she will appear on the Sun at n, shortly of her beginning of Egress, which will be later at Wardhuys and sooner at St. Cruz, than as seen from the Earth's center.

topic  
rules  
and  
facts

o.  
nat  
&  
im.  
hyps.  
on.  
re.  
to  
this  
me.  
at

at  
E  
?

o  
ie

o  
&

o  
o  
1

o

he  
de

to

llac  
les

sp,

co  
ter,

th-  
b,

in  
sit

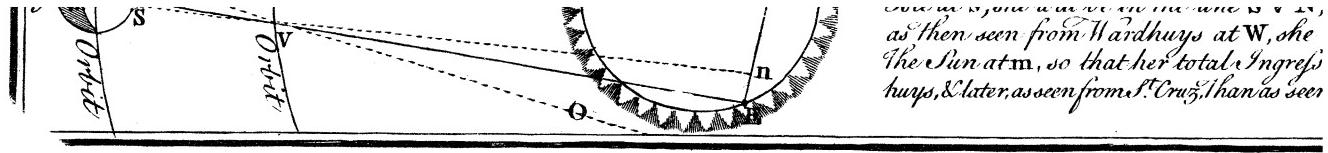
m  
h  
is  
es

is  
n

has

---

rry?  
tonus.  
g of.  
de?  
and  
shorter  
er at



as seen upon the sun, when  
at W, she will appear to be advanced upon  
Ingress will be sooner, as soon from Ward-  
an as seen from the Earth's center. —

near of measure, on the w<sup>ds</sup> & S, as seen from St. Cruz when at S; and  
as seen from Wardhuys, then at W, she will appear on the sun atn. shortly  
of her beginning of Egress, which will be later at Wardhuys and sooner at  
St. Cruz, than as seen from the Earth's center. —

J. Mynde sc.

ana  
shorts  
er at  
lynde sc.

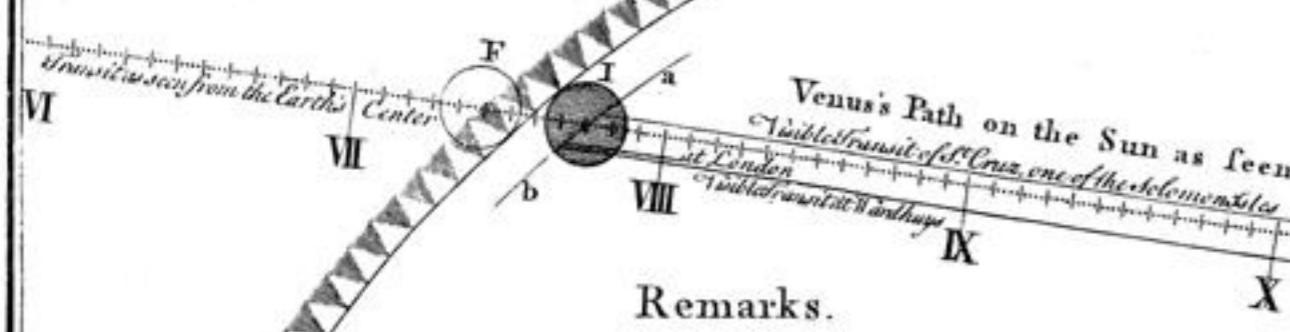
# The TRANSIT of VENUS over the SUN, June 3<sup>d</sup> 1769. Delineated by James Ferguson.

Scale of Minutes and Seconds of a Degree.

6	4	2	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
---	---	---	---	---	---	---	---	---	---	---	---	---	----	----	----	----	----	----

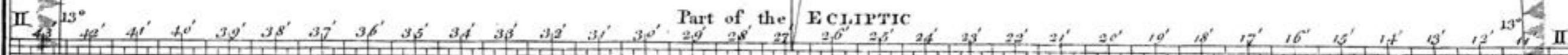
## EXPLANATION.

- F. Venus at her first contact with the Sun's eastern Limb.  
I. Venus at her Total Ingress for first internal contact.  
M. Venus at the middle of her geocentric Transit.  
E. Venus at her beginning of Egress from the Sun.  
L. Venus at her last contact with the Sun.

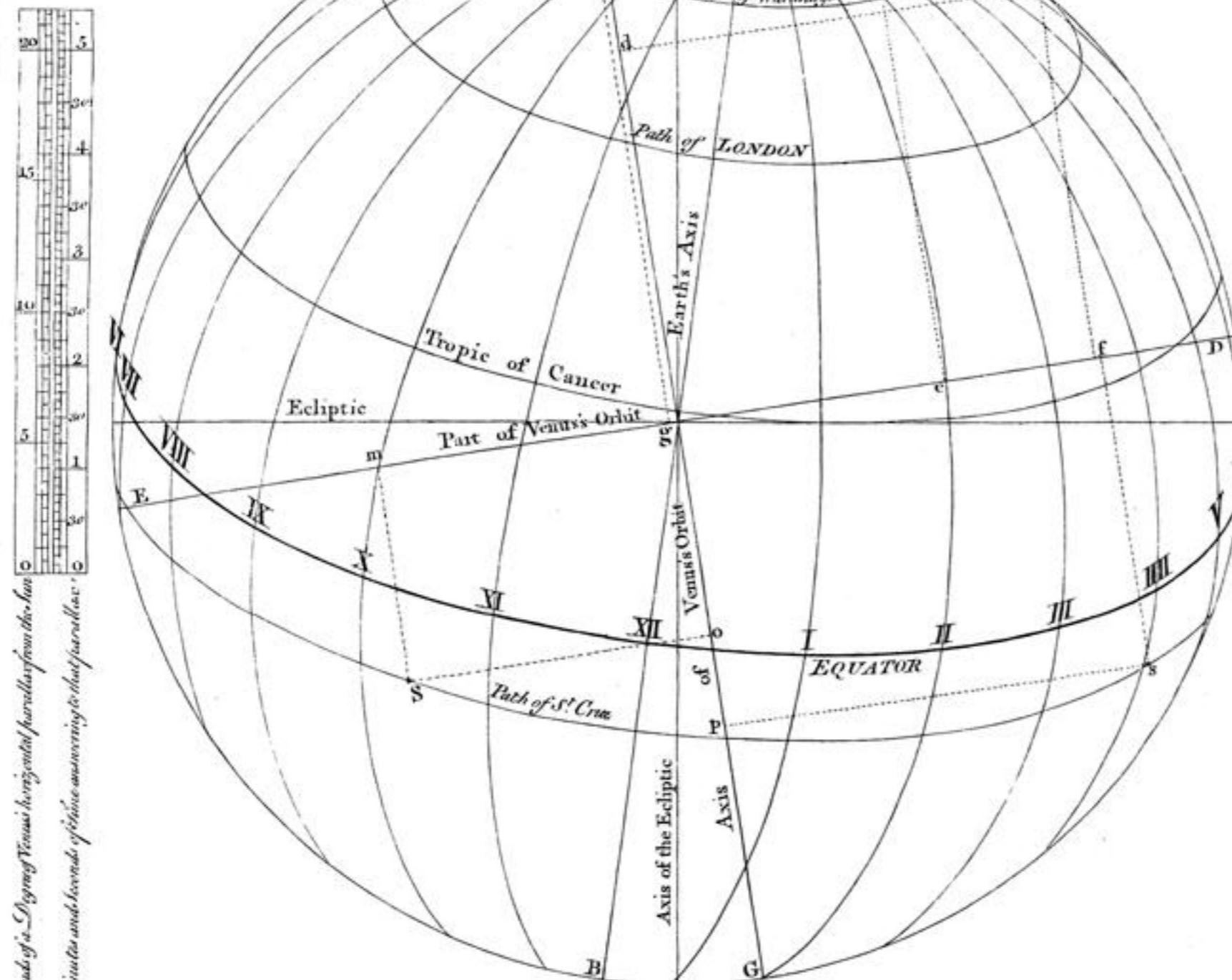


## Remarks.

The most proper place for observing this Transit would be Wardhuys upon Den in Norwegian Lapland, & some of the Solomon Islands (as St. Cruz) in the Great South Sea; for in both these places the whole Transit will be seen from beginning to end. Moreover in Lapland the time of the visible transit will be longer than the transit line supposed to be seen from the Earth's center, and the time of the parts disturbing it will be yet longer on account of its apparent motion being slower by Lapland moving the same way. But at the Solomon Islands the transit will be shorter than that supposed to be seen from the Earth's center, and that of Venus describing it will be still more shortened on account of the apparent quickness of her motion, arising from its being in a contrary direction to the motion of the Solomons Islands. We have assumed 8° for the quantity of the Sun's parallax in his declination, though that be its true quantity, the duration of the transit will be 25 minutes & seconds longer as seen from Wardhuys than as seen from the Solomon Islands supposing them to be west of London; the visible latitude of Venus at the middle of her transit will be 32° greater at those 10° less than at Wardhuys. If her Sun's parallax be either greater or less than 8° the difference of the visible durations of the transit will be greater or less accordingly, so that if these differences be well ascertained by observation, her Sun's parallax will thereby be found, and consequently his distance from the Earth, and from every other planet in the solar system.



Scale of 21° 3, equal to Venus's horizontal Parallax from the Sun and to the Semidiameter of the Earth's Disc in this Projection.



## An Orthographical Projection of the Earth's enlightened Disc as seen from the SUN during the time of the TRANSIT.

## EXPLANATION.

N.B. The Earth's enlightened Disc, on which are delineated the Equator, Tropic of Cancer, several Paths of Wardhuys, London, Island of St. Cruz, as seen from the Sun, and the parallaxes of Venus's longitude and latitude as seen from that Place, at 3 times of Venus's two internal contacts with the Sun.

E.g. D. A small part of Venus's Orbit, and b g G do. Axis.

N.B. The Earth's Axis and Universal Meridian. P is North Pole.

W. The situation of Wardhuys on the Earth's Disc as seen from the Sun at the time of Venus's total Ingress as seen from the Earth's center; & w. the situation of Wardhuys when Venus's Egress from the Sun begins.

W. Venus's parallax in Longitude = 30° 34' westward as seen from Wardhuys at the time of her total Ingress on the Sun as seen from the Earth's center, and W e her parallax in Latitude = 18° 35' southward at that time.

w b Venus's parallax in Longitude = 2° eastward as seen from Wardhuys at the time when her Egress from the Sun begins as seen from the Earth's center, and w g her parallax in Latitude = 21° southward at that time.

L. The situation of London on the Earth's Disc as seen from the Sun at the time of Venus's total Ingress as seen from the Earth's center.

L d. Venus's parallax in Longitude = 16° Westward as seen from London at the time of her total Ingress as seen from the Earth's center, and L f her parallax in Latitude = 21° at that time. Her Egress is invisible at London.

S. The situation of St. Cruz sole on the Earth's Disc as seen from the Sun at the time of Venus's total Ingress as seen from the Earth's center, and s. the situation of St. Cruz when Venus's Egress from the Sun begins.

S o. Venus's parallax in Longitude = 11° Eastward as seen from St. Cruz at the time of Venus's total Ingress as seen from the Earth's center, & S m her parallax in Latitude = 8° at that time. N. S. P. Venus's parallax in Longitude = 16° Westward as seen from St. Cruz at the time when her Egress begins as seen from the Earth's center, and S f her parallax in Latitude = 21° Eastward at that time.

All these parallaxes are measured on the Scale at the left hand, and the times by which the total Ingress of Venus, & her beginning of Egress, are accelerated or retarded by her parallax in Longitude, are found in the Scale, right against that parallax. An eastern parallax in Longitude retards the Ingress or Egress as seen from any given place, with respect to the time thereof as seen from the Earth's center, and a western parallax in Longitude accelerates it. A northern parallax in Latitude retards the time of Ingress, as seen from any given place, & accelerates the time of Egress, by the number of minutes that the half-transit line on the Sun's Disc is shorter as seen from the given place than as seen from the Earth's center, when Venus passes above the Sun's center, as in this Transit; & a southern parallax in Latitude accelerates the Ingress, and retards the Egress, as seen from any given place, with respect to the time thereof as seen from the Earth's center, by the number of minutes that the half-transit line on the Sun's Disc is longer as seen from the given place than as seen from the Earth's center. And these differences are found by measuring with compasses in the above Figure of the Sun's Disc, from the Axis of Venus's Orbit to the Arc a b where Venus's center is at the instant of total Ingress; and to the Arc c d where her center is when her Egress begins. And thus, the times of total Ingress, and beginning of Egress as seen from the above mentioned places, were founded excepted on the Table of the Times and Durations of the Transit.

## The Elements from which these Projections are deduced.

D. H. M. S.	
1. The time at Greenwich of Conjunction of the Sun & Venus, June 3. 10. 11. 0 P.M.	
2. Their true places in the Ecliptic then as seen from the Earth's center. 2. 13. 26. 51	
3. The Sun's Declination North. 22. 27. 20	
4. The Place of Venus's Ascending Node. 2. 14. 30. 14	
5. Her geocentric Latitude at that time. North Descending. 10. 22	
6. The angle of her visible path with the Ecliptic. 8. 30. 10	
7. Her geocentric horary motion for from the Sun. 3. 59. 1	
8. The Sun's distance from the Earth. 101523 The Sun's mean distance	
9. Venus's distance from the Sun. 7967 from the Earth's center	
10. Her distance from the Earth. 8896 being 100000 of such parts	

EXPLANATION. In this Diagram, S & W represent the Earth which turns on its Axis according to the order of the Letters. When Venus is in her Orbit at V, she will appear upon the Sun at L, at her total Ingress, as seen from the Earth's center, but at the same time, as soon from St. Cruz sole at S, she will be in the line SVN, not entered upon the Sun; and as then seen from Wardhuys at W, she will appear to be advanced upon the Sun at m, so that her total Ingress will be sooner as seen from Wardhuys, & later as seen from St. Cruz, than as seen from the Earth's center.

When Venus moves from V to S in her Orbit, St. Cruz moves the contrary way, from S to V, and Wardhuys the same way, from W to S. When Venus is in her Orbit, she will appear on the Sun at E, at her beginning of Egress, as seen from the Earth's center, but at the same time, she will be quite clear of the Sun, in the line S V O, as seen from St. Cruz, then at S; and as seen from Wardhuys, then at W, she will appear on the Sun at n, shortly of her beginning of Egress, which will be later at Wardhuys and sooner at St. Cruz, than as seen from the Earth's center.

